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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/806,118	03/23/2004	Edward Hurley	INTEL-0069	2131

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EXAMINER	
BEVERIDGE, RACHEL E	
ART UNIT	**PAPER NUMBER**
1725	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/11/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/806,118	HURLEY ET AL.	
	Examiner	Art Unit	
	Rachel E. Beveridge	1725	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 December 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12,14-17,31,32 and 35-43* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12,14-17, 31-32, and 35-43* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

Claim 12 is objected to because of the following informalities: on line 3, Applicant amended claim 12 to recite "is provided;" this is redundant language in the claim as that the claim already recites, "providing the pressurized inert atmosphere in the vacuum chamber." The examiner notes that removal of "is provided" will still allow the claim to maintain its clear limitation for providing the pressurized atmosphere in the chamber after providing an inert environment in the vacuum chamber. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-12, 14, and 37-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Mizuishi et al. ("Fluxless and Substantially Voidless Soldering for Semiconductor Chips," IEEE 38th Components Conference Proceedings) hereinafter referred to as "Mizuishi".

With respect to claim 1-12, 14, and 37-41, Sreeram discloses preparing a bonding surface of a heat dissipating member (Sreeram et al., col. 3, lines 27-30);

bonding a thermal interface material layer including a metallic solder to the bonding surface, the thermal interface material layer to thermally couple the heat dissipating member to a heat conducting component by an impermanent attachment (col. 3, lines 31-33 and 35-38) [claim 1]. Sreeram discloses bonding thermal interface material achieved without using solder flux (col. 4, lines 36-39) [claim 2], and bonding of the thermal interface material comprising forming an intermetallic bond (col. 3, lines 35-38) [claim 3]. Sreeram also discloses preparing the bonding surface comprising plating the bonding surface with at least one wetting layer (col. 7, lines 42-44) [claim 4], and the wetting layer comprising gold (Au) or Nickel (Ni) (col. 5, lines 58-59) [claim 5]. Sreeram discloses the metallic solder having a melting point that is greater than the operating temperature of the heat conducting component (col. 3, lines 63-67 and col. 4, lines 1-2, 26-28) [claim 6]. Sreeram discloses metallic solder comprising of indium or an alloy thereof (col. 5, lines 5-6) [claim 7], and a heat dissipating member comprising of copper or aluminum (col. 1, lines 14-15) [claim 8]. Furthermore, Sreeram discloses reflowing the metallic solder on at least a portion of the bonding surface to form a liquid metallic solder layer (col. 1, lines 51-55 and col. 7, lines 20-24), and allowing the liquid metallic solder layer to cool to a temperature of less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 9]. Sreeram discloses heating the metallic solder to a temperature of greater than or equal to the melting point of the metallic solder to form the liquid metallic solder (col. 3, lines 63-67 and col. 4, lines 1-2 and 26-28), and disposing the liquid metallic solder on at least a portion of the bonding surface to form a liquid metallic solder (col. 1, lines 51-55 and col. 7, lines 20-24) [claim 10]. Sreeram

also discloses allowing the liquid metallic solder layer to cool to a temperature of less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 14], bonding including providing the liquid metallic solder on the bonding surface (col. 1, lines 51-55 and col. 7, lines 20-24) [claim 39], and bonding further including the liquid metallic solder layer to cool (col. 3 lines 35-38) [claim 41]. However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions. Mizuishi discloses bonding including proving the solder perform (in between a semiconductor chip and heat sink) in a vacuum chamber under vacuum conditions and heating the material in the vacuum chamber to form liquid metallic solder (Mizuishi et al., "Experimental Procedures," p. 330, col. 2). Mizuishi also discloses providing a pressurized inert atmosphere (p. 330, col. 2; p. 331, col. 1; and p. 332, col. 2, more particularly Mizuishi discloses providing dry nitrogen gas to the evacuated chamber). Mizuishi discloses a fluxless solder ("Experimental Procedures," p. 331, col. 1) [claim 2], reflowing the metallic solder on the bonding surface to form liquid metallic solder layer, and allowing the liquid metallic solder to cool to a temperature of less than the melting point of the metallic solder (p. 330, col. 2) [claim 9]. Mizuishi also discloses placing the metallic solder perform and the heat dissipating member into the vacuum chamber (p. 330, col. 2), placing the vacuum chamber under vacumm conditions (p. 330, col. 2), and disposing the liquid metallic solder on at least a portion of the bonding surface to form a liquid metallic solder layer (p. 330, col. 2) [claim 10]. Mizuishi discloses providing a first inert environment in the vacuum chamber after placing the vacuum chamber under vacuum conditions (p. 330, col. 2) [claim 11], and providing the pressurized inert

atmosphere in the vacuum chamber after placing the vacuum chamber under vacuum conditions (p. 330, col: 2 and p. 331, col. 1 and 2; more particularly, "dry nitrogen gas") [claim 12]. Mizuishi also discloses removing at least a portion of the second pressure environment from the vacuum chamber (p. 330, col. 2 and p. 331, col. 1) [claim 14]. Furthermore, Mizuishi discloses the pressurized inert atmosphere being from about 15 to about 40 psi (see Mizuishi et al., p. 331, col. 1). The examiner notes that Mizuishi discloses that the ratio of evacuated pressure P_1 to increased pressure P_2 is preferably small (for example 1 torr/760 torr; Mizuishi et al., p. 331, col. 1); Mizuishi's disclosure of 760 torr is "about" 15 psi (775 torr) [claim 1]. It is the examiner's position that the amounts in question are so close that is it prima facie obvious that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corp. v. Banner*, 227 USPQ 773. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum soldering process and pressurized inert environment of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1) and to achieve a pressurized environment in the chamber where a substantially voidless solder bond can be formed (Mizuishi et al., p. 331, col. 1).

Claims 15- 17 and 42-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Mizuishi et al. ("Fluxless and Substantially Voidless Soldering for Semiconductor Chips," IEEE 38th Components Conference Proceedings) hereinafter referred to as "Mizuishi".

Sreeram discloses placing a metallic solder and a heat dissipating member having a bonding surface in a chamber (Sreeram et al., col. 3, lines 27-30), heating the metallic solder to a temperature greater than or equal to the melting point of the metallic solder to form a liquid metallic solder (col. 3, lines 63-67 and col. 4, lines 1-2, 26-28), the heated temperature being about 10°C to about 300°C (Sreeram et al., col. 2, lines 31-32 and 37-38; col. 3, lines 26-42); disposing the liquid metallic solder on at least a portion of the bonding surface to form a liquid metallic solder layer (col. 1, lines 51-55 and col. 7, lines 20-24), and allowing the liquid metallic solder layer to cool to a temperature of less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 15]. Sreeram discloses a metallic solder comprising a fluxless metallic solder (col. 4, lines 36-39) [claim 16], and a wetting layer including gold or nickel plating (col. 5, lines 58-59) [claim 17]. However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions. Mizuishi discloses a placing the metallic solder and a heat dissipating member having a bonding surface into a vacuum chamber (Mizuishi et al., p. 330, col. 1, "Introduction"; and p. 330, col. 2), placing the vacuum chamber under vacuum conditions (p. 330, col. 2 and p. 331, col. 2), heating the metallic solder (p. 330, col. 2), purging the vacuum chamber of oxygen gas ("evacuating"; Mizuishi et al., p. 331, col. 2) and providing a pressurized inert atmosphere in the vacuum chamber (p. 331, col. 1 and 2), the pressurized inert atmosphere having a pressure from about 0 to 100 psi (see Mizuishi et al., p. 331, col. 1). The examiner notes that Mizuishi discloses that the ratio of evacuated pressure P_1 to increased pressure P_2 is preferably small (for example 1 torr/760 torr; Mizuishi et al.,

p. 331, col. 1); Mizuishi's disclosure of 760 torr is "about" 0 to 100 psi (0-5171 torr) as that 760 torr is within the range of 0-5171 torr [claim 15]. Furthermore, Mizuishi discloses disposing the liquid metallic solder on the bonding surface to form a liquid metallic solder layer (p. 330, col. 2), removing at least a portion of the pressurized inert atmosphere from the vacuum chamber (p. 330, col. 2 and p. 331 "process"), allowing the liquid metallic solder layer to cool (p. 330, col. 2 and p. 331, col. 1) [claim 15]. Mizuishi also discloses fluxless metallic solder (p. 331, col. 1) [claim 16], and providing the wetting layer on the bonding surface prior to placing the heat dissipating member into the vacuum chamber (p. 330, col. 2, see step 1) [claim 17]. Also, Mizuishi discloses placing the vacuum chamber under vacuum conditions including removing a portion of the initial atmosphere from the vacuum chamber (p. 330, col. 2 and p. 331, col. 2) [claim 42], and removing the portion of the initial atmosphere includes removing oxygen gas from the vacuum chamber (p. 331, col. 1) [claim 43]. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum soldering process and pressurized inert environment of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1) and to achieve a pressurized environment in the chamber where a substantially voidless solder bond can be formed (Mizuishi et al., p. 331, col. 1).

Claims 31, 32, 35, and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sreeram et al. (US 6,653,741 B2) in view of Mizuishi et al. ("Fluxless

and Substantially Voidless Soldering for Semiconductor Chips," IEEE 38th Components Conference Proceedings) hereinafter referred to as "Mizuishi".

Sreeram discloses proving a metallic solder (Sreeram et al. col. 3, lines 31-33 and 35-38), heating the metallic solder to at least a melting temperature of the metallic solder (col. 3, lines 63-67 and col. 4, lines 1-2, 26-28), and allowing the heated metallic solder to cool to a temperature less than the melting point of the metallic solder (col. 3, lines 35-38) [claim 31]. Sreeram also discloses providing the heated metallic solder onto the bonding surface including bonding the heated metallic solder to the bonding surface without a solder flux (col. 4, lines 36-39) [claim 36]. However, Sreeram lacks disclosure of a vacuum chamber with an inert environment under vacuum conditions. Mizuishi discloses providing a metallic solder in a vacuum chamber under vacuum conditions (Mizuishi et al., p. 330, col. 2) by at least removing an amount of oxygen gas from the vacuum chamber ("evacuating"; Mizuishi et al., p. 331, col. 2), heating the metallic solder to at least a melting temperature of the metallic solder while in the vacuum chamber (p. 330, col. 2), proving a pressurized inert atmosphere in the vacuum chamber while the metallic solder is in the vacuum chamber (p. 330, col. 2 and p. 331, col. 1 and 2), the pressurized inert atmosphere having a pressure from about 0 to 100 psi (see Mizuishi et al., p. 331, col. 1). The examiner notes that Mizuishi discloses that the ratio of evacuated pressure P_1 to increased pressure P_2 is preferably small (for example 1 torr/760 torr; Mizuishi et al., p. 331, col. 1); Mizuishi's disclosure of 760 torr is "about" 0 to 100 psi (0-5171 torr) as that 760 torr is within the range of 0-5171 torr. Mizuishi also discloses providing the heated metallic solder onto a bonding surface

while the metallic solder is in the vacuum chamber (p. 330, col. 2), and allowing the heated metallic solder to cool (p. 330, col. 2) [claim 31]. Mizuishi discloses the inert atmosphere comprising nitrogen gas (p. 331, col. 2) [claim 32]. Furthermore, Mizuishi discloses removing at least a portion of the inert atmosphere from the vacuum chamber (p. 331, col. 2) [claim 35], and providing the heated metallic solder onto the bonding surface including bonding the heated metallic solder to the bonding surface without solder flux (p. 331, col. 1) [claim 36]. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum soldering process and pressurized inert environment of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1) and to achieve a pressurized environment in the chamber where a substantially voidless solder bond can be formed (Mizuishi et al., p. 331, col. 1).

Response to Arguments

Applicant's arguments, see pages 11-12, filed December 26, 2006, with respect to the rejections under 35 U.S.C. 103(a) over Sreeram et al. (US 6,653,741) in view of Totino et al. (US 2002/0079355) have been fully considered and are persuasive. The rejection of claims 1-17 and 37-43 over Sreeram et al. in view of Totino et al. has been withdrawn.

Applicant's other arguments filed December 26, 2006 have been fully considered but they are not persuasive.

Applicant argues that the applied references do not teach or suggest all the features of independent claim 1 (page 11). The examiner disagrees and notes that Sreeram et al. and Mizuishi et al. teach, disclose, and/or suggest all of the claim limitations including newly amended claim limitations as shown in the rejection of record above.

Applicant argues that Mizuishi does not suggest the claimed pressurized inert atmosphere for the claimed thermal interface material (page 12). The examiner disagrees. The examiner notes that the applicant merely claims a "thermal interface material" but has no claim limitations regarding the material properties or type of "thermal interface material." Mizuishi discloses a solder and pressures the chamber in order to achieve substantially voidless solder bonds" (Mizuishi et al., p. 331, col. 1). Thus, Mizuishi's solder clearly encompasses Applicant's broad claim limitation for a thermal interface material. Moreover, the motivation provided in the rejection of record above clearly shows that Mizuishi is also interested in arriving at similar results as Sreeram is interested in achieving; thus, there is sufficient suggestion to combine the two references because they are related to the same/similar fields of endeavor and they both are related to solving same/similar problems within the art. The examiner also reminds the applicant that Mizuishi teaches a thermal interface material used during solder bonding and that the rejections of record are over both Sreeram and Mizuishi combined, and not each reference individually. In response to applicant's argument that

there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art.. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention of Sreeram to include the vacuum soldering process and pressurized inert environment of Mizuishi in order to effectively bond a semiconductor to a heat sink and avoid oxidation and voids in the bonds (Mizuishi et al., p. 330, col. 1) and to achieve a pressurized environment in the chamber where a substantially voidless solder bond can be formed (Mizuishi et al., p. 331, col. 1).

The applicant then argues that the applied references do not teach or suggest all of the features of independent claim 15 (page 13), and that the applied references does not teach or suggest all of the features of independent claim 31 for at least similar reasons as previously argued (pages 13-14). The examiner disagrees and points the applicant to the rejection of record above over the newly amended claim limitations.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rachel E. Beveridge whose telephone number is 571-272-5169. The examiner can normally be reached on Monday through Friday, 9 am to 6 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

reb
April 10, 2007

JONATHAN JOHNSON
PRIMARY EXAMINER